

Revisions to the State Implementation Plan (SIP) for
Sulfur Dioxide (SO₂)

Milam County SO₂ SIP

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G. SULFUR DIOXIDE (SO₂) (New.)

1. Harris County SO₂ State Implementation Plan (SIP) Revision (No change.)
2. Milam County SO₂ SIP Revision (New.)

a. Introduction

Section 110 of the Federal Clean Air Act (FCAA) requires states to submit formal plans to achieve the national ambient air quality standards (NAAQS). Core requirements are to include emissions limitations, compliance schedules, air quality collection systems, and "self-correcting" mechanisms in the case that the plan proves to be unsatisfactory. The plan revision contained below is a small part of the overall air quality maintenance strategy for Texas. This revision is submitted by the Texas Natural Resource Conservation Commission (TNRCC) and applies only to SO₂ emissions in Milam County, Texas.

The air quality SIP for Texas has 10 control strategy divisions, A through J. Ozone reduction plans are now contained in Section B, the former section for SO₂ SIP revisions. The Harris County SO₂ SIP revision was originally attached to Section E, which also included lead control strategies. To organize the SIP more consistently by topic, all new SO₂ plans will be codified under

new Section G. The Harris County SO₂ SIP revision is the first subsection (G)(1).

A second subsection (G)(2) is the Milam County SO₂ SIP revision. Like the Harris County control strategy, this plan is restricted to a specific county, targeting large industries within its political boundaries. Likewise, the two counties are not officially designated as being "in nonattainment" of federal air quality limits for SO₂ (they are "unclassified"). Revisions were made to the SIP to maintain this good status and to prevent being designated as being in nonattainment by the Administrator of the U.S. Environmental Protection Agency (EPA).

This SIP revision is primarily concerned with the Aluminum Company of America (Alcoa) Rockdale Operations smelting plant and associated lignite-fired electric generating units near Rockdale, Texas, which are the largest SO₂ emission source in Milam County. Sulfur dioxide air emissions are regulated because of concerns about inhalation of SO₂ gases, which in the lungs can convert to irritating sulfuric acids. For asthmatics and chemically-sensitive people, this can be a debilitating condition called bronchoconstriction.

Justification for changing the overall plan is mainly due to conflicting regulations on sulfur emissions from the lignite-fired generating units. However, protection of public health and

welfare is re-evaluated because it is the primary state mandate. As shown below in a historical perspective, sulfur content in the local lignite fields triggered studies regarding air quality computer modeling, feasibility studies for pollutant control equipment, and a revised air quality monitoring network.

1) Historical background

On January 26, 1972, the former Texas Air Control Board (TACB) adopted regulations which limited SO₂ emissions from solid fossil fuel-fired steam generators to 3.0 pounds per million British thermal units (lb/MMBtu). The pertinent regulation was submitted to the EPA as part of the original SIP, which was approved on May 31, 1972.

Three lignite-fired units, named Sandow One, Two, and Three were built in Milam County in the early 1950s to provide power to an aluminum smelting plant constructed by Alcoa. The source of the fuel is the lignite field near Rockdale, Texas. Alcoa's engineers calculated the local coal sulfur content as being below 3.0 lb/MMBtu SO₂ when combusted, so this was a reasonable action by the TACB. However, as newer areas were opened for mining in the late-1970s, Alcoa discovered an increase in the average sulfur content of the lignite in their mine. Alcoa determined that complying with the 3.0 lb/MMBtu emission limitations was not as practical as anticipated.

In 1979, Alcoa petitioned the TACB to allow relaxed emission limitations for their power plant units. A proposed revision to the regulation, increasing the allowable limit to 5.0 lb/MMBtu, was published in the Texas Register on July 6, 1979. To support the proposal, Alcoa submitted technical feasibility studies and economic evaluations, supported by ambient monitoring data and dispersion modeling results. Both appeared to demonstrate modeled compliance with the NAAQS and Prevention of Significant Deterioration (PSD) increments for SO₂ emission levels.

At a public hearing conducted on November 13, 1979, Alcoa representatives modified their original petition. Alcoa volunteered to gradually lower the emission limit from 5.0 lb/MMBtu SO₂ to 4.5 lb/MMBtu in 1981, and eventually to 4.0 lb/MMBtu after January 1, 1982. Upon evaluation of public testimony, the TACB adopted this phased-in schedule on December 14, 1979, ultimately lowering the requirement to 4.0 lb/MMBtu, as it remains today in the Texas regulations (see 30 TAC §112.8). However, a formal SIP revision was not submitted to the EPA by the TACB.

Also in 1979, construction was begun on a new 545 mega-watt (MW) power plant, named Sandow Four, at a site adjacent to Alcoa's units. To support the operation of this unit, new lignite mine draglines and loading equipment were purchased to more than double the fuel capacity from 2.1 million to 5.6 million tons of lignite per year. While Sandow Four's contribution to ambient

SO₂ pollution is relatively low because of flue gas desulfurization (FGD) technology, the emission rates are considered to be significant when compared to other SO₂ sources in Texas. Table 1 shows the reported emission rates in grams per second of SO₂.

Table 1. SO₂ Stack Emission Rates

Source	Grams SO ₂ per Second
Sandow One and Two	1,511 (Combined stack.)
Sandow Three	756
Sandow Four	861

Source: Appendix G-2-1

Sandow One, Two, and Three have no FGD emission controls because they are grandfathered; they were constructed before the applicable EPA regulations for fossil fuel-fired steam generators were proposed on August 17, 1971. While TNRCC permits regulate Sandow Four emissions, the main thrust of this SIP revision is to ensure that a sulfur limit relaxation at Sandow One, Two, and Three will result in acceptable levels of SO₂ concentrations and exposures.

2) Legal issues

On May 5, 1981, the EPA issued a Notice of Violation to Alcoa for exceeding the 3.0 lb/MMBtu SO₂ limit. Although the TACB increased the limit to 4.0 lb/MMBtu in a 1979 rule change, the EPA decided that a change in SO₂ allowances would require a formal SIP revision. According to the EPA analysis, Alcoa could comply

by working with the TACB to draft a SIP revision to allow greater lignite sulfur content. To facilitate this relaxation, the EPA provided funds to the TACB in 1985 and 1986 to help with the computer modeling of the Rockdale Operations facility.

Therefore, the air quality agency for Texas, now the TNRCC, has a working rule [30 TAC §112.8(b)] and an Agreed Order (see Appendix G-2-5), but another SIP revision needs approval by the EPA Administrator. Alcoa's Rockdale Operations industrial process is described below.

b. Description of Alcoa's Rockdale Operations

Alcoa's operations near Rockdale include three principal components: an aluminum smelting plant, lignite-fueled power plants, and a lignite surface mine. These facilities employ about 1,700 people at full production level. The three components must be taken as an integrated emission source, even though the power plant emissions have the greatest impact on air quality.

1) Overview

Rockdale is the last surviving aluminum smelter in Texas; four were located in Texas after the close of the World War II effort. Since 1954, the Rockdale plant has depended on electrical power from three lignite-fueled steam electric generating units:

Sandow One, Two, and Three. These older facilities supply about 50 percent of the power required by the aluminum smelter and its associated facilities. Alcoa owns Sandow One, Two, and Three. Electricity generated by Sandow Four supplies the remainder of the power that Alcoa needs, and the surplus power is supplied to the Texas Utilities power grid. Sandow One, Two, and Three generate electrical power of which 100 percent is consumed by the aluminum smelter. Under certain circumstances, excess power from Sandow Four is sold to the power grid, under a contractual agreement between Alcoa and Texas Utilities. According to plant managers, the four lignite-fueled units run at near-capacity every day of the year except for short periods of outages and routine maintenance.

The TNRCC staff recognizes the need for affordable power for the Rockdale Operations facility, since major capital expenditures could impair the facility's economic viability. Economic evaluations of several repowering and control technologies were submitted by Alcoa in 1979. Current technologies are discussed briefly in section (d) of this document.

2) Aluminum smelting plant

The Rockdale aluminum smelting plant began operation in 1952 with four potlines. Two additional potlines were added in the mid-1950s and two more were added in the late 1960s, for a total of

eight. Each potline consists of two separate potroom buildings, which operate 24 hours a day. Each potroom houses between 72 and 80 electrolytic cell pots. A pot is a large steel shell lined with carbon that has steel collector bars embedded in the lining. The bars are connected to an external cathode wiring system used to transfer the direct current (100,000 amperes at 4.5 volts) from one pot to the next.

To obtain aluminum product, electricity is routed through the metal pots, which contain ore in the form of refined bauxite (alumina) in an acidic bath. In engineering terms, alumina is reduced to pure aluminum by a cathode deposition process. Each double row of cells is called a potline, since they are connected in a series to the same high-voltage source. This same process has been used since the early 1950s at Rockdale.

When each potline was constructed, state-of-the-art fume collection and treatment equipment for fluoride emissions was installed. As explained in the following sections, the first process controls were designed to reduce potentially hazardous fluoride emissions, with SO₂ reductions as a secondary, but important, benefit.

The first six potlines were equipped with three-stage treatment systems consisting of cyclone separators, electrostatic precipitators, and wet-lime scrubbing towers. The Rockdale plant

presently has five potlines equipped with this technology, which can remove about 20 to 30 percent of the SO_2 in fumes from these specific potlines. Alcoa later developed a fluidized bed dry scrubbing technology known as the A-398 process, which was installed on potlines 7 and 8 when they were constructed in the late-1960s. Line 5 was later retrofitted with A-398 units (A-398 units do not remove SO_2).

Each smelting cell is equipped with hoods, end doors, and ductwork to collect and direct fumes to a treatment system. A small portion of the vapors escape through cracks or between hoods or around doors, and some fumes escape when end doors or hoods are temporarily removed for certain operating procedures, such as removing molten metal or spent carbon anodes, setting new anodes, and covering carbon to reduce air burning. Effort is made to perform potroom operations so that at least 95 percent of emissions are collected and sent to the fume treatment system.

3) Anode electrolysis emissions

The source of SO_2 emissions is the sulfur contained in carbon materials which are used to manufacture anode blocks. These anode blocks are used, and ultimately consumed, in the smelting process. To make anode blocks, an aggregate of sized coke fractions is mixed with pitch and pressed into blocks weighing about 850 pounds each. Layers of these blocks are then stacked

into pit furnaces and slowly baked to a finishing temperature of 1,100 degrees Celsius. A block remains in a furnace for about four weeks.

A portion of the sulfur in the anode blocks is driven off as SO_2 during the baking cycle. The anode baking furnaces (numbers 160 and 162/164) are equipped with A-446 fume treatment units which capture emissions utilizing fluidized beds of alumina. In addition to capturing fluoride, some SO_2 is adsorbed onto the alumina, which is transferred to potrooms and used as a portion of the feedstock for the smelting pots. The fluoride becomes part of electrolytic bath material and the SO_2 is driven off by the heat of the smelting bath.

Some of the nearly-spent anodes, called butts, are recycled. Typically, 75 percent new coke and 25 percent returned anode butts are used in manufacturing new anodes. With eight potlines in operation, a total of almost 25,000 anode blocks are contained in the pots and each block is slowly consumed over a 20-day period. Five percent of the blocks are replaced each day, and the "setting" of new blocks in the pots is spread over all three daily shift crews. No significant short-term variations in SO_2 emissions occur from an aluminum smelting plant because of the uniform occurrence of anode replacement and the overall uniform nature of the smelting process.

Molten aluminum is periodically siphoned into a crucible, which is then transferred to the ingot department where it is cast into solid pigs or large sheet ingots. Some of the molten aluminum is transferred to a nearby facility where it is atomized into aluminum powder. Given the overall manufacturing process, other sources of SO₂ emissions are further clarified below.

4) Sandow One, Two, and Three

Sandow One, Two, and Three are lignite-fueled power plants with generating capacities of 121.55 MW each. Combined, they supply approximately 50 percent of the power requirements for the smelting operations. To provide this energy, 100 to 115 tons per hour per boiler of mined and crushed lignite must be delivered to the lignite dryers where the moisture is reduced from its as-mined content of 30 to 35 percent to approximately 5.0 percent. This moisture reduction is necessary for the lignite to be used as fuel for the Sandow boilers. A small portion of the lignite is burned as dryer fuel, so that approximately 60 to 75 tons per hour of dried lignite is supplied to each of the three steam generators.

The steam generators each produce approximately one million pounds per hour of high pressure, high-temperature steam. The dry-lignite firing process is unique, since most power plants burn as-mined pulverized lignite or coal. The steam generators

are tangentially-fired, water-cooled, wet-bottom units made by Combustion Engineering, Inc.

In addition to the mining, handling, and drying of fuel, the power generation units require extensive auxiliary support equipment such as conveyors, pumps, fans, air compressors, dust removal equipment, auxiliary boilers, and ash disposal equipment. Particulate matter emissions (PM_{10}) from the drying facility are controlled by wet venturi scrubbers. The PM_{10} emissions from the boilers are controlled by electrostatic precipitators. As with the fluoride controls in the smelter potrooms, the smokestack scrubbers and precipitators are not intended to remove SO_2 emissions.

5) Sandow Four

Sandow Four is a joint project between Alcoa and the Texas Utilities Electric Company to augment power needed for operation of the smelter. The 545 MW lignite-fired power plant is operated under a contractual agreement to supply most of its power to Alcoa. Under New Source Performance Standards (NSPS), 40 CFR 60, Subpart D, Sandow Four is subject to a more stringent SO_2 emissions limitation of 1.2 lb/MMBtu.

Sandow Four is a relatively new power plant employing a tangential, supercritical boiler manufactured by Combustion

Engineering, Inc. Approximately 414 tons of pulverized lignite are burned per hour, generating 4,125,000 pounds of steam to supply a 545 MW General Electric turbine generator. Flue gas from the boiler (5,983,000 pounds per hour at full capacity) contains combustion by-products, fly ash, and excess air. After treatment by a high efficiency particulate collector, the flue gas then passes through a limestone SO₂ removal system known as an FGD.

Pollutant contributions from Sandow Four were modeled as being less than 0.1 percent of the three-hour SO₂ NAAQS and less than 9.0 percent of the annual NAAQS at receptors, where the highest-second-high concentrations were predicted. However, because its emission point is at higher elevation than Sandow One and Two, maximum impacts from Sandow Four could occur at different modeling receptors (see Appendix G-2-1).

6) Lignite Mine

Basic functions of the Rockdale Operations lignite mining are: stripping the overburden to expose the lignite seam, loading and transporting fuel to the crushers and stockpiles, processing the lignite for use in the power plant, and reclaiming the mined land. Overburden is removed with two electrically-powered draglines to expose the lignite, each with a bucket capacity of more than 100 cubic yards. Each dragline has a 360-foot boom and

weighs approximately 13 million pounds. The draglines move up and down the length of a five to six thousand foot long open pit, exposing a lignite seam 120 to 160 feet wide.

The exposed lignite is gathered with electric and diesel machinery, which load the lignite on to 130-ton trucks. The lignite is either hauled to the crusher and conveyed to the power plant, or is stockpiled at a facility adjacent to the crusher facilities for later conveyance. Lignite fuel is then processed for use in the Sandow boilers.

The sulfur content of the lignite deposit varies by mining location. In 1972, when the SO₂ emission limitations of 3.0 lb/MMBtu was originally considered by the TACB, Alcoa believed they would have little difficulty in complying. As stated in the Introduction, an increase in sulfur content was detected as new areas of the mine were opened. Subsequently, a core drilling program was initiated to define the area-wide sulfur levels in the lignite. Data collected from this program indicated that compliance with the 3.0 lb/MMBtu limit would not be possible, so the 1979 petition to relax the limit was submitted to the TACB. A core sample drilling program and mining plan review is continuing.

After final lignite removal, the land is reclaimed. The reclamation process begins with leveling the spoils to a gently sloping

terrain. The land is then revegetated with grasses and trees in order to support land management objectives.

The sulfur content in the lignite is the main source of SO₂ emissions at the Rockdale Operations (pyrites and elemental sulfur). As shown above, sulfur is also contained in the anodes used in the smelter potrooms and, to a limited extent, in the alumina ore transferred from the anode baking furnace A-446 units.

c. Dispersion modeling analyses

Dispersion modeling is used to demonstrate that ambient SO₂ concentrations are predicted to be below the NAAQS and allowable PSD increments. This dispersion modeling integrates historical meteorological data and continuous industrial emissions to predict whether the population outside of a facility's property could be exposed to SO₂ levels above applicable health-based standards.

Alcoa contracted with the Sigma Research Corporation (now called Earth Tech) to perform this modeling analysis. A preliminary dispersion modeling report was submitted to the TNRCC in January 1994. The TNRCC modeling staff evaluated this report and requested additional information in a March 4, 1994 Staff Audit Report. Alcoa responded with supplemental information on

April 15, 1994, and submitted another progress update on June 6, 1994. The TNRCC staff requested clarification of several technical issues and requested a third modeling analysis, which was submitted to the TNRCC on September 22, 1994.

The TNRCC staff accepted this report in a letter to Alcoa dated October 13, 1994. After that report had been submitted and approved, the company discovered that a significant error had been made in the velocities of emissions from the A-398 fume treatment units on three potlines. A revised report was submitted on May 8, 1995. The final modeling report is included in Appendix G-2-1, which describes the air quality modeling approach used and details the results of the NAAQS and PSD analyses, which were performed using five years of meteorological data.

The models chosen are recommended as preferred models by the EPA's Guideline on Air Quality Models and were run using practices generally consistent with the EPA's regulatory recommendations. The modeling also incorporated a new Sandow Three stack into the analysis, using Good Engineering Practice (GEP) stack height analysis. Dispersion modeling normally consists of the three following procedures: an area of impact analysis, NAAQS analysis, and a PSD increment consumption analysis.

1) Area of impact (AOI) analysis

For the AOI analysis, Alcoa's Sandow One, Two, and Three were modeled with the Industrial Source Complex -- Short Term (ISCST2) model. A 1.0 lb/MMBtu emissions rate, representing the proposed increase in allowable SO₂ emissions from 3.0 to 4.0 lb/MMBtu, was used. This 1.0 lb/MMBtu increase is equal to 365.91 grams per second (g/s) of SO₂ at combined units One and Two, and 182.85 g/s for Sandow Three. Initially, the AOI was estimated to be a 150 kilometer (km) radius. Alcoa's proposal to increase the stack height of Sandow Three resulted in a reduction of the AOI to 100 km. The TNRCC staff provided a Point Source Data Base retrieval to enable evaluation of non-Alcoa sources within the 100-km AOI. Alcoa was required to include these sources prior to any comparisons with the NAAQS or PSD increments.

Topographic features such as hills were not included in these preliminary model runs, which generally assumed the EPA's default conditions. The calculated concentrations were compared with 75 percent of the NAAQS and PSD increments; receptors with concentrations above 75 percent were identified for further model runs using more refined techniques. Next, a more detailed modeling effort was conducted, in which receptors were placed at 100-meter intervals within areas where predicted concentrations were at least 75 percent of NAAQS or PSD limits. Terrain elevations were included for this iteration.

Results from the more refined modeling indicated that there were some additional points at which predicted concentrations were greater than 75 percent of the federal standards. An improved receptor grid was then developed for use in final runs. For the final model run, receptors were placed at 100-meter intervals around these additional points. Using this technique, the AOI and preliminary modeling demonstrated compliance with the NAAQS and the PSD increments.

2) NAAQS analysis

Point sources other than the smelter scrubber stacks (the Sandow units, the lignite dryer, furnace stacks, and auxiliary boilers) were modeled with the ISCST2 model. The smelter scrubber stacks and potline roof vents were modeled as being line sources, using the Buoyant Line and Point Source (BLP) dispersion model. Results of the ISCST2 and BLP modeling runs were summed to provide ambient concentrations on an hourly basis for each receptor, and ambient concentrations were compared with the primary and secondary NAAQS. The NAAQS limits are:

Table 2. National SO₂ Standards

NAAQS	Micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)
Primary Annual SO ₂	80
Primary 24-hour	365
Secondary 3-hour	1,300

To demonstrate compliance with the SO₂ NAAQS, two alternatives were used (based on smelter production levels and sulfur content in the anodes). When the smelter plant is at full capacity, eight potlines and 41 emission points are evaluated. Each emission point consists of one or more smelter plant stacks with each bank of A-398 stacks evaluated being equivalent to a single point source. Full capacity operation was modeled using 2.6 percent sulfur in the anode coke.

A seven-potline scenario was modeled by excluding Line 1 and six associated scrubber stacks, and using 3.0 percent sulfur in the coke. As shown in Appendix G-2-1, these modeling runs predicted no violations of the applicable NAAQS.

3) PSD increment consumption analysis

In addition to the NAAQS evaluations, the EPA requires that some new sources or major modifications emitting criteria pollutants must undergo PSD analysis (40 CFR part 52). Milam County is classified by the EPA as a Class II area for the purpose of establishing its allowable PSD increments (there are no Class III areas in Texas). Numerical increments for SO₂ are defined in Table 3 as the maximum increase above baseline, ambient concentrations. In effect, the PSD program is meant to help protect public health and welfare while allowing industries some flexibility regarding growth and emissions increases.

Table 3. Class II PSD Increment Standards for SO₂

PSD Increment	µg/m ³
Annual SO ₂ average	20
24-hour	91
3-hour (Secondary.)	512

For the PSD analysis, the main Alcoa increment-consuming sources are Sandow One, Two, and Three. These sources were modeled with ISCST2 using only a 1.0 lb/MMBtu emission rate, representing the proposed increase in allowable SO₂ emissions from 3.0 to 4.0 lb/MMBtu. Sandow Four also consumes PSD increment and that unit was included in the modeling. The modeling predicted some exceedances of allowable PSD increments, primarily due to non-Alcoa sources located near Elgin, Texas in an area about 30 km to the southwest of the Alcoa facility. These exceedances were close to a facility owned by the Acme Brick Company.

Additional analyses were conducted for the non-Alcoa sources to the southwest. Exceedances were for a second time indicated near Elgin, but they were located inside the private property owned by the Acme Brick Company. When the Acme Brick SO₂ contribution is removed, the remainder is below the appropriate PSD increment. The TNRCC's Modeling Section procedures, which were based on the EPA's policies, allow the removal of such exceedances in cases where they occur on private property of a facility and would not

exceed the PSD increment without the contribution of that facility.

d. Evaluation of alternative control options

Several options for controlling SO₂ emissions at the Rockdale Operations have been evaluated for potential use at the power plant over the last 15 years. Fuel sulfur conditioning, repowering, and smokestack FGD equipment are new, emergent technologies when compared to the 1950s air quality engineering. Given the unique dry-lignite fueling system and the large capital costs involved, however, many of these promising alternatives are impractical. These alternatives apply only to Sandow One, Two, and Three.

1) Blending of western coal

Blending of low-sulfur western coal with local lignite would reduce power plant emissions, but the economic and technical feasibility of this option is questionable. Sandow Units One, Two, and Three use wet-bottom slagging boilers from which bottom ash is removed in a molten state. The slagging characteristics of a lignite and western coal mixture may not allow the slagging to occur properly. Aside from these technical concerns, the economy of importing western coal is considered to be cost-prohibitive, and would result in local mining lay-offs.

2) Limestone scrubber

Limestone scrubbing can remove SO_2 from flue gas streams. Wet scrubbing involves passing the flue gas stream through a mist of limestone slurry which collects the SO_2 . This type of technology is primarily used where there is a need to remove greater than 75 percent of the SO_2 from the gas stream. These high removal rates are not needed to protect ambient air concentrations in this case. Major equipment modifications such as new fans, ductwork, and water treatment systems, and other major equipment modifications would be needed for this option. Large volumes of solid waste generated from the operation of the scrubber would have to be handled. High capital and operating costs make this option infeasible for Rockdale Operations.

3) Lignite beneficiation (coal washing)

Coal washing can remove sulfur from the lignite fuel. Coal washing is accomplished by running raw coal through one or more jigs and separating out the unwanted particles such as pyrites and clays. The technology for coal washing has only been attempted on a pilot scale basis. Neither the reaction that washed fuel will have in the power plant dryers, nor the effect on slagging characteristics of the boiler itself, are known. Washing is not a proven technology for lignite. Coal washing generates solid waste problems and may result in a loss of about

10 percent of the Btu content of the incoming fuel. In view of these uncertainties, the capital costs, and operating costs, coal washing is not considered to be a feasible technology for the Sandow power plant.

4) Natural gas co-firing

Natural gas co-firing has been used in some boilers and can reduce SO₂ emissions. This control option for the units at Rockdale might prove to be technologically difficult. The introduction of natural gas in the amounts needed may adversely affect the slagging characteristics that the boilers need to operate properly. Boiler modifications would be required and would include at least burner modifications and perhaps replacement of pressure parts due to the unique design of the boilers. Additional engineering is required to determine if this option will work effectively. This option is not feasible to comply with a SO₂ standard less than 4 lb/MMBtu due to higher fuel costs and capital costs associated with a new natural gas pipeline.

5) Dry sorbent injection

This control technology utilizes a dry powder injected into the flue gas ahead of the electrostatic precipitators (ESPs). The powder reacts in the flue gas stream and removes some of the SO_2 . The additional solids loading on the ESPs could lead to an increase in PM_{10} emissions. There is also a problem in handling the solid waste generated by this process because the powders are generally water soluble. High capital costs and higher operating costs make this option infeasible for Rockdale Operations.

6) Repowering

Repowering consists of the installation of high-efficiency gas turbines and the utilization of the existing turbine-generator in combination with a new waste heat boiler using the exhaust gases off the gas turbines. This combined cycle process is very energy efficient and would drastically reduce sulfur emissions from the plant; but, capital requirements are high and the continuing fuel costs are greater than the lignite's cost.

7) Conclusion

Each of the control options would require major capital expenditures and increases in normal operating costs. Given the economy and supply of the world-wide aluminum industry and that the cost of power for the Rockdale Operations is the highest in Alcoa's system, a mandate to use one these options would threaten the

economic viability of Rockdale Operations. During public hearing testimony in the 1979 regulation, "Allowable Emissions from Solid Fossil Fuel Fired Boilers" (former 30 TAC §113.04), Alcoa clarified its technical reasons for discounting fuel switching and other emission control alternatives. High capital costs would be especially impractical and unnecessary since existing modeling studies and ambient SO₂ monitoring demonstrate that the national air quality standards were truly protected. To evaluate alternatives on an equivalent long-term basis, an analysis of present value cash flows over a twenty year period using a twelve percent discount rate was submitted and is reproduced below:

Table 4. Comparison of Alternative Control Technologies in Millions of Dollars

Alternative	Capital Costs	1st Year Costs	Net Present Value
Western Coal Blending	21.00	8.50	70.90
Limestone Scrubbers	30.00	1.96	36.90
Lignite Beneficiation	25.00	3.92	45.20
Natural Gas Co-firing	5.30	7.15	49.50
Dry Sorbent Injection	2.50	8.07	53.00
Repowering	102.00	9.10	145.60

e. Monitoring plans

As an interim step in the SIP process, Alcoa and the TNRCC entered into Agreed Order No. 94-04-A, which was passed and

approved on April 13, 1994 (see Appendix G-2-3). This Agreed Order stipulated that Alcoa shall "provide ambient SO₂ and meteorological monitoring data from its existing and any future ambient SO₂/meteorological monitoring systems as reasonably requested by the Executive Director or his designee." Pertinent data have been provided to the TNRCC since April 15, 1994, and will continue to be submitted. Alcoa is currently operating a monitoring network with three monitors collecting data on SO₂ concentrations, fluoride, wind speed, and wind direction. This monitoring network is described in Appendix G-2-2. Monitoring reports submitted to the TNRCC show no exceedances of the NAAQS.

On November 28, 1994, Alcoa provided a report proposing a new, improved SO₂ sampling site with meteorological monitoring equipment and information necessary for the TNRCC to assess the Quality Assurance Project Plan (QAPP), pursuant to 40 CFR Part 58. This report is being reviewed by the TNRCC staff and both the Radian monitoring location report and the final QAPP are attached to Appendix G-2-2. Specific compliance dates for completing Alcoa's ambient monitoring network are reported in the two referenced Agreed Orders. The ambient monitoring network design and related quality assurance measures are an integral part of this SIP revision (see section h, relating to compliance).

f. Operating restrictions

The following operating restrictions are placed upon the Rockdale Operation Facility:

1) Potline production

Alcoa's final modeling report contains results which show the maximum anode sulfur content to be used for various numbers of potlines in operation without exceeding the NAAQS or allowable PSD increments (see Appendix G-2-1). With fewer operating potlines, a higher average sulfur content is allowed in the petroleum coke. These scenarios were modeled to maximize operating flexibility without degradation of the NAAQS or PSD increments. These results are summarized as follows:

Table 5. Control Requirements for Potlines

Number of Potlines	Percent Anode Coke Sulfur
8	2.6
7 or less	3.0

The scenarios reflected in the modeling runs assumed that potlines 7 and 8, the newest and largest ones at the Alcoa facility, would not be shut down. Individual impacts depend on which of the potlines remain in operation, but in every case the total concentrations remain well below the NAAQS. Such regulatory flexibility is required because Alcoa may impose slow-downs or ramp-ups due to the market conditions for aluminum.

Notification of the TNRCC Waco Region Director is required if Alcoa decides to increase or decrease the number of aluminum smelter potlines in production. In addition, Alcoa must contact the EPA Region VI Office to provide notice of production line changes.

2) Limitation on Power Generation

In order to protect the annual NAAQS standard, an annual limit of 3.1 million MW-hours on power generation from Sandow One, Two, and Three shall be imposed. This limit was used to calculate the annual average for all four operating scenarios modeled above. Surveillance is easily enforced, since power generation from the three power plants is continuously metered.

3) Proposed Agreed Order

An Agreed Order with Alcoa was developed to be part of this SIP revision. The order is a binding document which imposes monitoring, recordkeeping, and reporting requirements on Alcoa to help ensure that actual conditions do not exceed the operating conditions in the SIP. The Order addresses the maximum number of potlines in operation, limitations on the percent sulfur in the petroleum coke, petroleum coke sampling requirements, initial and final pollution compliance demonstrations, annual power genera-

tion limits, and other reporting requirements. The proposed Agreed Order is included as Appendix G-2-5.

4) Closure of FM 1786 and construction of alternate route

The TNRCC modeling staff predicted excesses of the NAAQS on a public roadway, Farm-to-Market Road 1786 (FM 1786), which was originally built as an entrance into the plant. Alcoa confirmed these possible impacts in their preliminary modeling efforts. The location of the roadway is shown in Appendix G-2-4. The EPA modeling guidance requires that receptor locations be placed at locations to which the public potentially has access. Preliminary modeling contained receptor grids every 100 meters (328 feet) down the centerline of the road. Because exceedances at these receptor locations could not be avoided without costly emission controls, Alcoa began to evaluate the possibility of acquiring a 2.4-mile section of FM 1786 in order to privatize the road and its right-of-way. By privatizing the road, no receptors would be required and the previously modeled exceedances could be ignored since they would create no public impacts.

In October 1993, a public hearing was held by the Texas Department of Transportation (TxDOT) to consider privatization of this road. Considerable public opposition to road closure was voiced by local citizens. Alcoa and Milam County subsequently negotiat-

ed to provide an alternate route as part of the county road system, resolving the citizen complaints. On January 27, 1994, the Texas Transportation Commission approved Minute Order 103282 to approve the road closure, contingent upon completion of the alternate roadway.

The final modeling results shown in Appendix G-2-1 do not include receptor grids placed on FM 1786. On April 13, 1994, the TNRCC approved Agreed Order No. 94-04-A, which specified that Alcoa "shall use its best efforts to complete, on or before December 31, 1994, construction of a county road to be maintained for public use in accordance with the terms of an agreement between Alcoa and Milam County." The new county roadway was completed in September 1994, and was accepted as an alternate route by TxDOT on October 27, 1994. This allowed the 2.4-mile section to be removed from the State Highway System, and on November 23, 1994, the Governor of Texas signed the deed transferring this section of roadway back to Alcoa. This satisfactorily resolved the TNRCC staff concerns about placing receptors on FM 1786 and about controlling public access to an area where exceedances had previously been modeled.

With the closure of the former FM 1786, which is the entrance to the Rockdale Operations Facility, measures are to be taken to restrict public access. A gate has been installed, and security guards patrol for unauthorized ingress. The TNRCC and Alcoa

commit to improving the security surrounding the property by considering video monitoring, extra patrols, and other measures.

g. Sandow Three stack height increase

Alcoa is presently building a new stack for Sandow Three to increase the height of the Sandow Three emission point from 81 to 161 meters. This construction is required to avoid the downwashing effect caused by the presence of large nearby structures. One of the effects caused by increasing stack height is to disperse emissions over a larger area, resulting in lower ambient concentrations without a true emissions reduction in g/s. To limit over-crediting, the EPA adopted regulations which define GEP as the stack height necessary to ensure that emissions do not result in excessive concentrations due to atmospheric downwash or wakes created by terrain or structures in the vicinity of a source. These regulations, promulgated under 40 CFR Part 51, regulate stack height "credits" instead of actual stack height.

A GEP stack is defined under 40 CFR 51.100(ii) by a formula that relates stack height to the dimensions of nearby structures, thus restricting stack increases to the modeling height necessary to avoid over-crediting by dilution. It also specifies certain site-specific demonstrations that are required to justify increase of an existing stack to GEP formula height. However, an EPA interpretation of this rule (stated in a July 29, 1992 memo

from the EPA's Office of Air Quality Planning and Standards to the EPA Regional Directors) waives the requirement for a site-specific demonstration if a new structure has been built since the construction of the original stack. Thus, the siting of a new nearby structure removes a presumption that the original stack height is the GEP height, since the new structure may create downwash effects that were not anticipated in the original stack design.

In Alcoa's case, the stack for Sandow Three was built in the early 1950s and Sandow Four was subsequently built in the late 1970s on adjacent property. The presence of the Sandow Four structures created new downwash effects. Therefore, a stack height increase is allowed by the EPA's stack height regulations, as long as it is within the height specified by the stack height formula. The EPA determined that Alcoa's proposed stack height, 161 meters, is within the allowable height as defined by 40 CFR 51.100(ii). Agreed Order 94-04-A specified that "By June 1, 1995, Alcoa shall complete construction and installation of a 161 meter stack at Sandow Unit 3...." The new stack tie-in for Sandow Three was completed in April 1995.

h. Enforcement, recordkeeping and reporting

Major industrial facilities such as Alcoa's Rockdale Operations Facility must comply with specific emission reporting require-

ments. Under the requirements of 30 TAC §112.2, a facility subject to SO₂ limits must demonstrate compliance with stated engineering methods. Alcoa has complied with the requirements of 30 TAC §112.2 (relating fuel sampling and analysis) by conducting semi-annual stack testing for SO₂ emissions using EPA Method 6. Also, Alcoa has conducted emissions sampling in accordance with 30 TAC §101.8, which requires facilities report to the TNRCC the results of compliance demonstrations upon request.

1) SIP compliance determination systems

The EPA regulation 40 CFR 51.111(d) requires that each SIP identify methods for determining compliance with emission limitations. Section 8.4 of the interpretive document entitled SO₂ Guideline (EPA-450/2-89-019) states: "For some types of sources, EPA regulations require SIP revisions to require source continuous monitoring to determine compliance (see 40 CFR Part 51, Appendix P).... If a State does not have plants that meet these qualifications, these provisions need not be included in the SIP." This exception is clarified in a subsequent edition of the SO₂ Guideline (EPA-452/R-94-008): "In some situations, continuous emission monitoring systems (CEMS) technology might not be feasible so alternate means of compliance might be necessary." The State certifies that Alcoa's Rockdale Operations Facility is not subject to requirements for CEMS, as further explained below.

Sandow One, Two, and Three are not covered by Paragraph 2.1.2 of Appendix P because SO₂ pollution control equipment has not been installed on those units. In view of the recall and delay of enhanced monitoring regulations proposed as 40 CFR Part 64, and the economic burden of installing enhanced monitors before the rules are finalized, Alcoa has proposed an alternate compliance methodology. The TNRCC staff agrees with the spirit of the Alcoa proposal regarding interim SIP compliance.

A new Agreed Order is proposed and included as Appendix G-2-5, which provides the required, legally enforceable mechanism for determining compliance with SO₂ stack emissions limitations. The proposed Agreed Order requires that until proposed 40 CFR 64 for enhanced monitoring (58 FR 54648) becomes final, compliance shall be demonstrated by quarterly stack testing for SO₂ using EPA Method 6, 6a, 6b, or 6c. Quarterly stack testing is sufficient during the interim period because significant variations in the as-mined sulfur content of lignite are not expected. The proposed Order requires that once regulations under 40 CFR Part 64 for enhanced monitoring become final, those regulations shall apply to Sandow One, Two, and Three and shall become the method for determining compliance with the SO₂ limitations contained in the SIP.

In addition to quarterly stack testing, compliance with the SIP shall be demonstrated by the use of two ambient monitors owned by

Alcoa. Alcoa shall report to the TNRCC the SO₂ levels and other required data on a quarterly basis. Alcoa's monitors are not to be considered as National Ambient Monitor Systems, State and Local Ambient Monitor Systems, or Special Purpose Monitors. Instead, Alcoa's monitors are intended to require negotiated corrective actions at the process manufacturing level, should the need arise. In the event that a federal or state SO₂ standard is exceeded, certain corrective actions shall be undertaken.

Continuous compliance with the SIP shall also be determined by the use of coal sulfur sampling. As-mined coal shall be collected, prepared, and analyzed in accordance with EPA-recognized methods. One 24-hour composite sample shall be prepared using ASTM Method D2013-86. Sample sulfur content, moisture content, and caloric value (Btu) shall be calculated using appropriate ASTM methods. A 30-day rolling average shall be calculated by using equation 19-20 of EPA Method 19, 40 CFR part 60, Appendix A. As stated in the attached Agreed Order in Appendix G-2-5 of this SIP revision, Alcoa is required to contact the TNRCC and EPA if there are any exceedances of the 4.0 lb/MMBtu standard.

2) Limit on power generation

The limit on annual gross power generation of 3.1 million MW-hours from Sandow One, Two, and Three must be imposed in order to help protect the annual NAAQS. Compliance is determined by

keeping records of the power generated from these units, which is continuously metered. The proposed order requires that these records be maintained for a period of three years and be made available to the TNRCC upon request.

3) Limit on anode sulfur content

Limits on percentage sulfur in petroleum coke used in Alcoa's anode baking process were modeled (as reported in Table 4) and were necessary to avoid exceedances of the NAAQS. Compliance with these limits will be controlled by a review of the documentation of sulfur content of incoming petroleum coke shipments. Suppliers of petroleum coke perform tests of sulfur content in accordance with current American Society for Testing Materials standards, and provide Alcoa with documentation of sulfur content with each shipment. The Agreed Order in Appendix G-2-5 includes provisions for the recordkeeping, reporting, and testing of petroleum coke. Documentation of the sulfur content used in the anode baking process must be maintained for three years and made available to the TNRCC upon request.

4) Limit on public access

This SIP requires that Alcoa take adequate, precautionary measures to limit public access to the Rockdale Operations Facility. Trespass warning signs, access gates, and roving patrols may be

used to help discourage illegal entry. Such voluntary restrictions are not included in the proposed Agreed Order because compliance would require the use of video cameras and intensive TNRCC oversight, which are not considered to be practicable or cost-effective in remote areas. Should egregious occurrences of ingress and egress be found to occur, the TNRCC shall work with Alcoa to further limit public entry on an informal, good-faith basis.

i. Federal policy and guidelines

Alcoa is legally bound by the requirements of this SIP revision. The 1970 FCAA, as amended in 1977 and 1990, requires states to submit implementation plans that indicate how the state intends to attain and maintain the primary and secondary NAAQS for SO₂. The requirements for general SIPs were included in Part A, §110 and in Part D, §171 through §178 of the FCAA. The FCAA Amendments of 1990 did not make significant changes to these requirements for SO₂ attainment areas, so past EPA SIP guidance is still relevant to the extent that it has not been superseded by new regulations or guidance documents. Excerpts from key EPA policies are summarized in SO₂ Guidance (EPA-450/2-89-019). Appropriate air quality modeling techniques are specified in the EPA's Guideline on Air Quality Models (Revised).

Section 110 of the Clean Air Act specifies elements that each SIP must contain. These elements are briefly discussed as follows:

- A description of regional air quality;
- A comprehensive emission inventory;
- Emission limitations and compliance schedules necessary for NAAQS attainment;
- A permit program for new sources;
- Monitoring and reporting requirements; and
- Enforcement procedures.

This SIP revision contains all of the required elements. First, the air quality control region is identified as Milam County, Texas, which contains a large SO₂ emission source in TNRCC Region 9 (Waco, Texas). A detailed dispersion modeling analysis was conducted and submitted as part of this SIP revision in Appendix G-2-1. To satisfy the requirement for a description of the ambient air quality, areas where over 75 percent of the NAAQS or PSD could occur were identified and five years of meteorological data were used. No exceedances of any ambient air quality levels were predicted and none have been detected in the past.

Second, a detailed emission inventory retrieval was supplied to the modeling consultant and included in the model, satisfying the requirement for a comprehensive emission inventory. A possible PSD violation at one SO₂ source, the Acme Brick Company, was

resolved because the indicated impacts were on Acme's private property, which was the source of the SO₂ emissions.

Third, emission limitations for Sandow Units One, Two, and Three were established in 1972 and revised in 1979, and are submitted to the EPA for approval as part of this SIP revision. The existing SO₂ emissions limit is 3.0 lb/MMBtu. The new limitation shall be 4.0 lb/MMBtu for the purposes of this SIP revision. Initial and continuing demonstrations of compliance are required under the terms of the proposed Agreed Order, and a schedule for the compliance demonstrations is included.

Fourth, the TNRCC currently has a New Source Review (NSR) program in place that would apply to any new or modified sources with potential SO₂ impacts on air quality in Milam County, satisfying the EPA's requirement for a permit program for new sources. The NSR program applies to the entire State of Texas and imposes non-attainment area review in specific conditions.

Fifth, the proposed Agreed Order specifies monitoring and reporting requirements, which are adequately described in this SIP revision. Quarterly stack testing and ambient sampling data are required to be sent to the TNRCC and maintained on-site for a period of at least three years. Quality assurance procedures will comply with EPA Method 6, 6a, 6b, or 6c for stack testing, until the time that it is superseded by federal enhanced monitor-

ing requirements. The ambient monitoring analysis program shall comply with the measures contained in the TNRCC's QAPP for Alcoa. In addition, Alcoa shall conduct a fuel sulfur sampling analysis program as a SIP compliance determinator.

Sixth, the Agreed Order specifies enforcement procedures which will ensure that the NAAQS and the allowable PSD increments are not exceeded. A major component of the enforcement plan is to hold the Rockdale Operations Facility to a combination of pot-lines with specified limits on anode sulfur content. In addition, TNRCC Region 9 and EPA Region VI conduct field investigations to ensure that violations of the SIP are not occurring. If violations of ambient air quality are detected, corrective actions shall be imposed. To the extent that this SIP is found to be unprotective of the applicable air quality standards arising from legal challenges, changes to the permits, or changes to the NAAQS itself, the plan shall be revised and resubmitted for public comments and EPA review.

According to a 1980 EPA policy memorandum and paragraph 2.2(c) of Appendix V to 40 CFR 51, all SO₂ SIPs must include information regarding maximum allowable emissions, which are calculated from air quality models and in-use engineering data. The following information is submitted:

Milam County SO₂ SIP Revision Information

1. Plant name and address: Alcoa Rockdale Operations, P.O. Box 472, Rockdale, Texas 76567.
2. Revised SO₂ emission limit: 4.0 lb/MMBtu heat input.
3. Maximum allowable: the change in Texas regulations submitted as an allowable SIP revision will increase maximum SO₂ emissions by 17,000 tons per year.
4. Actual SO₂ emissions: actual emissions from Rockdale Operations will not increase because it operates in compliance with applicable TNRCC regulations [30 TAC §112.8(b), see Appendix G-2-6].
5. A public hearing was held in Rockdale, Texas on June 14, 1995.

Appendix G-2-1

Dispersion Modeling Analysis

Appendix G-2-2

Ambient Monitoring Network

Appendix G-2-3

Agreed Order 94-04-A

Appendix G-2-4

FM 1786

Appendix G-2-5

Proposed Agreed Order

Appendix G-2-6

30 TAC Chapter 112.8

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

30 TAC CHAPTER 112

(REGULATION II)

CONTROL OF AIR POLLUTION

FROM SULFUR COMPOUNDS

EFFECTIVE OCTOBER 23, 1992

§112.8. Allowable Emission Rates From Solid Fossil Fuel-Fired Steam Generators.

(a) Except as provided in subsection (b) of this section, no person may cause, suffer, allow, or permit emissions of sulfur dioxide (SO₂) from any solid fossil fuel-fired steam generator to exceed 3.0 pounds per million Btu (MMBtu) heat input averaged over a three-hour period.

(b) No person may cause, suffer, allow, or permit emissions of SO₂ from any solid fossil fuel-fired steam generator located in Milam County, which began operation prior to January 1, 1955, to exceed 4.0 pounds per MMBtu heat input averaged over a three-hour period.

(c) Units having a design heat input of greater than 1,500 MMBtu per hour and, which on January 1, 1991, were not subject to New Source Performance Standards, shall meet one of the following requirements:

(1) After July 31, 1996, no person may cause, suffer, allow, or permit emissions of SO₂ from any solid fossil fuel-fired steam generator to exceed 1.2 pounds per MMBtu heat input averaged over a three-hour period or an equivalent in total allowable annual site emissions, or

(2) The owner/operator of the unit(s) shall fund and support a research study of winter atmospheric haze, also known as "white haze," in the Dallas/Fort Worth (DFW) area, to be completed by July 31, 1996. Within 90 days from the effective date of this rule, the owner/operator shall submit a formal proposal for this study designed to allow successful completion of this study by the date specified above. The proposal shall include milestone dates, the study's general approach and objectives, and shall include minimum and maximum financial responsibilities on the part of the owner/operator. The Texas Air Control Board (TACB) Executive Director shall approve or reject the study within 120 days from date of the proposal submittal. The TACB shall base its approval or rejection on the technical merits and adequacy of approach to the research study. Should the proposal be rejected, an extension not to exceed 60 days for renegotiation may be granted at the discretion of the Executive Director. Should this extension expire without proposal approval, then subsection (c)(1) shall apply. Following such approval, the study shall be directed by a steering committee selected by the TACB in consultation with the owner/operator of the unit(s) and shall be controlled, comprehensive, state-of-the-art, and quality-assured. The steering committee shall define the scope of the study and establish appropriate milestones to assure completion of the study by July 31, 1996. The study shall be designed to demonstrate conclusively whether or not a reduction of SO₂ emissions from the affected unit(s) to 1.2 pounds per MMBtu will significantly improve winter visibility in the DFW area. No later than

October 31, 1996, the TACB shall make a finding based on the study as follows, either:

(A) that reductions of SO₂ emissions from the affected unit(s), as defined in subsection (c) of this section, will significantly improve winter visibility in the DFW area. If such finding is made, then the affected unit(s) shall achieve compliance with a SO₂ emission limit of 1.2 pounds per MMBtu or an equivalent in total allowable annual site emissions by July 31, 2000, or

(B) that reductions of SO₂ emissions from the affected unit(s), as defined in subsection (c) of this section, will not significantly improve winter visibility in the DFW area. If such a finding is made or if the TACB can not make a finding on the basis of the study by October 31, 1996, then the affected unit(s) shall maintain compliance with subsection (a) of this section.

(d) Except as provided in subsection (e) of this section, beginning September 30, 1994, solid fossil fuel-fired steam generators of greater than 250 MMBtu heat input per hour which are equipped with SO₂ control equipment shall be equipped with a continuous emissions monitoring system (CEMS) for SO₂. The CEMS shall be installed, calibrated, and operated as specified in 40 CFR Part 51, Appendix P, hereby incorporated by reference.

(e) In lieu of the requirements of subsection (d) of this section, beginning September 30, 1994, sources subject to §412(c) of the Federal Clean Air Act as amended in 1990 shall meet the requirements of §412(c) and the regulations promulgated thereunder.

09/18/92